An Innovative Network to Improve Sea Ice Prediction in a Changing Arctic

Sea Ice Prediction Network (SIPN)

Our goals are to
- Improve sea ice forecasts
- Advance the Sea Ice Outlook
- Improve sea ice models
Sea Ice Outlook (SIO) is our starting point to build a network.
Synthesized 338 SIO Contributions

Example for the “Pan-Arctic September” contributions

Synthesis of 2008-2013 by Larry Hamilton
Updated from Stroeve, Hamilton, Bitz, & Blanchard-Wrigglesworth (2014)
Advanced Analysis of SIO Contributions

Example for the “Pan-Arctic September” contributions

This style of figure appears in the SIO report for June, July, and August.
Advanced Analysis of SIO Contributions

Example for the September “Sea Ice Probability” (SIP) contributions

Multi-model Mean SIP

2014 Observed Extent

Extent is 1 where concentrations exceed 15%
SIP is the ensemble mean extent
Goals for Today

1) Discuss End Users’ Needs
2) Discuss Experiments for 2015 and Beyond (Idealized and Initialized)
Upcoming Related Meetings

EGU 2015, 12 - 17 April 2015 (deadline for abstract submission: 07 January 2015, 13:00 Central European Time): CL3.4/AS1.4/CR6.5/OS1.9 Polar Climate Predictability and Prediction

Polar Sea-Ice Seasonal and Inter-Annual Predictability Workshop 8-10 April 2015, Reading, UK (will be advertised on SIPN website, email Ed Hawkins for more info now)
They follow the Outlook and find interesting but not useful for operations.

Need ice conditions (fracture, open drift, freeze-up, strength, ice pressure) on ship route. Definitions of open/ice-free depend on ship capability.

Need to know reliability record.

Would like to know how conditions compare to climatology.

Minimum lead time for utility is about 3 weeks.
Matthieu Chevallier Spent a Year at Total Energy

Slide prepared by Matthieu after serving as sea ice modeler with Total in 2008

We learnt a lot from each other but:

- **Regional sea ice area/extent: too low resolution information**
  - Sub-basins (Barents sea, Kara sea...) are split into sub-sub-basins (NE/SW Kara sea) based on metocean conditions… ➔Question for SIPN

- **Point-wise information: not interested in sea ice concentration**
  - Model can bring lot of information (ice thickness distribution, ice age…) ➔This is the point!!!
  - More interested in mechanical aspects…
Sea ice prediction information needs

• White paper in the works, led by Adrienne Tivy
• Interviews & input from:
  – FedNav, Canada
  – B. Harland, VP Operations Crowley Marine
  – Shell Ice Management Division
  – G. Deemer, UAF
  – Additional research underway
  – Other relevant efforts (AOOS survey, EU-ACCESS ice navigation study)
• Links to IARPC Sea Ice Collaboration Team
  Milestone 3.1.1b (Engage with stakeholders & users to determine sea ice forecasting & products needs)
• Greg Deemer M.S. thesis (UAF): Evaluation of Arctic Cap Nowcast/Forecast System & community-based observations in informing NWS forecasts
Lessons learned from the 2014 SIO modeling contributions
By François Massonnet (additions by Cecilia)

+ All groups run ensembles of simulations, most with more than 10 members
+ Uncertainty associated with stochastic atmospheric forcing is well evaluated
+ Some groups have started providing local-scale information
- Uncertainty associated with initial conditions is not systematically evaluated
- Uncertainty associated with model parameters/physics is not evaluated
+ Predictions become more confident (individually and as a group) over time
- Not all models have provided an evaluation of their retrospective forecast skill
SIPN Experiments

2014 April Workshop Challenge: Requested 2013 Outlook repeated with a 1m perturbation to the Initial Conditions

Change to Area Forecast by Month

- Starts small in May/June (perturbation not meant to alter area at the start)
- Lead by Ed B-W

By September Response is -2 to -4.5 x10^6 km^2
SIPN Experiments

2014 April Workshop Challenge: Requested 2013 Outlook repeated with a 1m perturbation to the Initial Conditions

Lessons learnt:

• Ambiguous how to perturb models with Ice-Thickness Distribution, known as g(h)
• Ambiguous how to deal with regions with less than 1m thickness
• Not all models initialize at the same time (April/May/June)
• Not enough time to contribute, low participation
Planning a New Experiment

To be lead by Muyin Wang and Ed B-W

- Initialize with the same May 1 thickness (a climatology and an estimate of 2015)
- Provide \( g(h) \) from PIOMAS (also mean ice thickness and ice covered fraction)
- Provide an optional regional mask of central Arctic where PIOMAS \( g(h) \) is to be prescribed, so groups can opt to use their own state estimate in MIZ.

Why?
- To avoid incompatibilities with data assimilation/model biases.
- Only the thickness in the central Arctic has a significant influence on September forecast.

The mask will have a transition zone to blend between PIOMAS \( g(h) \) and model's own \( g(h) \), also allowing for anomaly initialization in MIZ.
Planning a New Experiment

- We will provide a climatological May g(h) and the regional mask in January so groups can get started.
- We will create a SIPN Experimenter’s Wiki for participants to share progress, questions, hurdles, etc.
- We want experimental results in at least one ensemble (ideally ~10) both raw and bias corrected.

Expected Results?
1) measure of multi-model spread to same initial conditions
2) measure of sensitivity of models to 2015 conditions compared to climatology